VITAMIN A AND β-CAROTENE IN BANASPATI GHEE, PRODUCED IN NWFP PAKISTAN AND STABILITY OF VITAMIN A DURING FRYING, COOKING AND AT EXPOSURE TO AIR AND LIGHT

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ACKNOWLEDGEMENT

Sincere thanks are extended to the following persons who initiated this study and for their continued interest during the course of this investigation.

1. Dr. Mushtaq A. Khan,Senior Chief, Health and Nutrition Planning and Develpment Division, Government of Pakistan, Islamabad.
2. Dr. Mohammad Mansoor, Consultant, Micronutrient Initiative (MI) and UNICEF, Islamabad
3. Mr. Baidar Abbas, Asstt Chief, Nutrition P&D, GOP, Islamabad.
4. Ms. Farzana Yasmeen, Lecturer, Dept. of Agric. Chem. NWFP Agri. University, Peshawar.
5. Mr. Haroon, Maqsood, Umar Farooq, Abid Hussain, Anwar, Miss. Afsheen Rauf, Shazia Anbar, graduate students of our department who helped in the collection and preparation of samples for analysis.

Financial assistance for this study received from UNICEF, Islamabad is gratefully acknowledged.

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INTRODUCTION

Significance

Vitamin A deficiency affects multiple physiological system. It causes night blindness, xerophthalmia, damages the respiratory, genitourinary and G.I.Tract, impairs growth and bone formation. Anemia and increased susceptibility to infection are now associated with hypovitaminosis A in preschool children (1). As vitamin A has a well documented role in human immune response which has implication for treatment of diarrheal diseases and measles (2, 3).

Hypovitaminosis or vitamin A deficiency is considered as one of the major nutritional deficiency disease, affecting population in developing regions, with 73 countries having been identified as potential endemic areas (4). Problems of deficiency have been documented in Bangladesh (5). India (6). Indonesia (7), Nepal (8) and Thailand (9). Data on the prevalence of hypovitaminosis A has only recently become available from other region of the world including African continent, Latin America and Mediterranean (10).

Asia along with other countries has traditionally been considered the area at highest risk of xerophthalmia. In Pakistan 60% of the child death are due to diarrhea and respiratory infection, that are highly associated with vitamin A deficiency.

According to micro nutrient survey 1976-77 (11) in Pakistan, 60% of male and 71% of non-pregnant/lactating female and 79% of pregnant women consume less than 70% of the RDA of vitamin A. Based on the available data, it is highly probable that Pakistani children both in rural and urban areas are at significant risk for vitamin A deficiency, xerophthalmia and associated diseases. A community based study (12) on children under 2 years of age in Peshawar revealed that 59% of the children had marginal vitamin A deficiency. Similarly a study conducted by NIH (13) reported the prevalence of bitot spot as 0.2% in children under 5 years. The available epidemiological data of vitamin A deficiency suggests that clinical vitamin A deficiency in Pakistan is rare but sub-clinical vitamin A deficiency does exist which may be partly responsible for increasing childhood morbidity and mortality.

In Pakistan the per capita consumption of ghee and oil has been reported to be 33 gm per day per person. (NNS 1985-87) (14). While the finding of the Federal Bureau of Statistic show per capita consumption of ghee as 27 gm per day with 1.5, 2.7 and 23.0 for butter, desi ghee and banaspati ghee respectively (15).

The absorption rate of carotenoid is 20-25% of that of retinol which is estimated at 70-90% (16). It has been reported that the median dietary intake of vitamin A in the US is composed of approximately 25% provitamin A and 75% preformed vitamin A, (17) with dairy and fortified food being the major contributing dietary items. In contrast, studies from developing countries suggest that upto 80% of the dietary intake of vitamin A comes from provitamin A food sources (18).

The normal concentration of vitamin A is 20-25 mcg per 100 ml plasma and less than 10 mcg/100 ml are considered as poor and deficient level (19). If more than

5% of the population has deficient level of serum vitamin A, (less than 10 mcg/100 ml), then it is a public health problem in that population/country.

In Pakistan, vegetable oil (ghee) is consumed universally as cooking material by all age groups and it can be used as vehicle for fortification with vitamin A. Fortification of common vegetable oil/ghee is feasible and an important step towards improving the nutritional status of the population. Also as per Pure Food Law 1965, the manufacturers are supposed to fortify the hydrogenated oil with a fixed quantity of vitamin A, 33 iu/ gm or 9.9 ug/gm. In U.K. the margarine must contain by law 8 ug/gm of vitamin A (20).

Due to population growth, the demand for hydrogenated oil has been increasing every year, but its supply is limited and can not keep pace with the increased demand. In order to keep a balance between supply and demand, the government has given a number of incentive to both public and private sectors for increase production of hydrogenated oil.

The manufacturer thereafter directed their whole attention towards the increased in quantity and little attention was given to the quality, with the result that the quality has adversely effected. A recent study to find out vitamin A content in ghee and oil produced in Pakistan indicated that 40% of the samples had upto a maximum of 50% fortification, while 60% of the samples contained even less than half of the recommended level of vitamin A fortificant (21).

Stability of Vitamin A

Carotenoid and retinol are affected by pH, enzyme activity, light and oxidation. As a consequence of these chemicals changes, preformed vitamin A or provitamin A content of raw food item may be reduced in food preparation. Red palm oil in its raw form is considered one of the richest source of provitamin A (22). After heating to 200°C for 30 minutes, the ß-carotene content become negligible. Another study in Bangladesh reported losses of upto 43% in green leafy vegetable following traditional method of boiling and subsequent frying (23). Other workers have reported that processing of fruit and vegetable results in estimated 15-20% reduction in vitamin A potency in green leafy vegetable and 30-35% in yellow vegetable (24). Similarly losses of upto 40% in preformed vitamin A source like fish following boiling have also been reported (25).

Studies have also shown that stability of vitamin A fortified oil allowed at room temperature 23°C depends on the presence of oxygen and light. The stability of vitamin A in oil stored in sealed cans is excellent even after 9 months, however the oil stored in open container where it is exposed to both oxygen and light the vitamin A becomes unstable after 6 months and 50% of initial vitamin A remains after 9 months. Vitamin A is quite stable during manufacturing process and during storage at room temperature. Margarine showed minimum loss after 6 months at 50°C, while stored at 23°C it showed 15% losses during the same period (25).

Atwood et al (26) showed a loss of 35-45% in vitamin A in CSB after 28 weeks of transport, storage and exposure for 30 days in open pails. However, there were minimum loss in vitamin A fortified oil as long as the pails remained unopened. They also observed 30% loss on day 30th after opening the pails of the initial level.

Frying however can destroy vitamin A. The amount of loss depends on the number of time the oil is used for frying. After repeated frying for 4 times, 60% loss of vitamin A has been observed and after 12 consecutive frying almost all vitamin A is lost. Vitamin A losses in margarine occurs under extreme conditions. Heating it at 160°C, 180°C, 200°C for 1½ hours results in average losses of 20, 35 and 50% respectively. However, vitamin A survives the baking process in biscuit, cake and bread prepared with vitamin A fortified margarine (27). Another study has revealed that 58% of vitamin A was retained after 4 repeated frying of potato in the same oil. This indicate that vitamin A palmitate added to refined soybean oil remain stable during commonly used cooking methods (28).

The typical cooking method in Pakistan are curry making, deep frying and shallow frying but curry making is universally adopted by general population.

Some manufactures in Pakistan have noted that the quality of procured stock of vitamin A fortificant is substandard. Beside this, quantitative test for the quality control is not available in the manufacturing units. Moreover proper mixing of vitamin A during packing is another problem faced by the manufacturers.

Considering the above problems the present project was initiated to find vitamin A and ß-carotene content in fortified banaspati ghee at the production line and in the sealed products. The potency of vitamin A in the original fortificant used by manufacturers, and to observe the possible losses of vitamin A during shallow, deep frying and in the preparation of curry dishes and also in open tin at retailer shop.

OBJECTIVE

1. To test and determine the Vitamin A (trans retinol and beta carotene content) separately in the products at the production line after mixing vitamin A and after sealing the products from all banaspati ghee manufacturing units in NWFP.

2. To test the potency of vitamin A fortificant used by the manufacturers in the production of banaspati ghee.

4. To determine the percent retention of vitamin A and beta carotene in ghee/oil after shallow frying, deep frying, repeated use of oil and during preparation of curry.

4. To observe the possible losses of vitamin A in retailer shops using 16 kg open tin at regular interval of 1, 2, 3 and 4 weeks.

GENERAL OBJECTIVES

The general objective of the study is to identify strategies and actions aimed to improve the current practices and level of vitamin A fortification of banaspati ghee and oil at the manufacturer's level.

MATERIAL AND METHODS

I. Collection of Ghee Samples and Vitamin A Fortificant

a) A team consisting of 4 researchers visited ghee and oil industries located in NWFP. A questionnaire was prepared which was filled/completed during visits to the industries. The number of ghee/oil industries, their annual production and brand names is given in Annexure-I.

b) During the visits to various industries, the researchers collected representative samples of vitamin A fortificant used by the manufacturers for mixing in their products.

c) Representative random samples of ghee at the production lines after mixing it with vitamin A and in the container (tin) after sealing the product were also collected.

The samples were placed in coloured bottles, brought to the laboratory and kept in refrigerator for subsequent analysis for vitamin A and ß-carotene.

II. Determination of Vitamin A (Trans Retinol) and ß-carotene.

Vitamin A, (trans retinol) and ß-carotene content in the vegetable ghee samples were determined by HPLC (Perkin Elmer) using the procedure given below:

Standards and Reagents:

Vitamin A (all trans retinol) and ß-carotene were obtained from Sigma Chemical Company (St Louis, MO, USA).

Vitamin A (trans retinol) and ß-carotene Standard Solutions:

Standard Vitamin A Solutions:

Standard solution containing 2, 4, 6, 8 10 ug/ml of vitamin A were prepared in hexane and also in petroleum ether. The concentration of working solution were determined from absorbance measurement in a UV/VIS spectrophotometer at 325 nm as follows:

retinol, iu/ml = Abs_{325} x 18.3 (29).

Standard B.Carotene Solutions:

Standard solutions of B.carotene were prepared in hexane. The concentration of working solutions were determined from absorbance measurement in a UV/VIS spectrophotometer at 450 nm as follows. ß-carotene, mcg/ml = Abs_{450} x 4.17.

The B.carotene was converted to retinol equivalent, iu/ml = Abs_{450} x 4.17 x (1/0.6) (29).

Saponification and Extraction:

The extraction procedure developed was an adaptation of (30, 31). Duplicate ghee samples (2 - 3 g) were weighed into a round bottomed flask covered with aluminum foil. To the test portions were added 100 ml of ethanol, 50 ml of 50% KOH solution and 0.5 g of ascorbic acid. The mixture was refluxed for 60 minutes with an air condenser and then cooled to room temperature. The contents of the flask were transferred quantitatively to a separatory funnel,

covered with aluminum foil. The flask was rinsed with 100 ml petroleum ether and then 50 ml water and the contents were added to the separatory funnel. The funnel was inverted, then shaken vigorously, and the layers were allowed to separate. The bottom layer was run off and discarded. The ether layer remaining in the funnel was washed 3 times with distilled water to remove KOH. Absolute ethanol (5 ml) was used in case of emulsion formation. The extracts were evaporated under vacuum to dryness in a rotary evaporator. The vacuum was broken by introducing nitrogen gas and the residue were immediately dissolved in hexane containing ethanol (2 ml) in the volumetric flask and was diluted to volume with hexane. The extraction procedure was carried out under subdued light. The extracts obtained were flushed with nitrogen gas and stored in the dark at -18°C until required for chromatography.

HPLC Conditions:

Extracts were analyzed by High Performance Liquid Chromatography (HPLC) in a Perkin Elmer HPLC system consisting of a 250 isocratic LC Pump, with a 20 ul loop injector Model 7125-075 Rheodyne valve (Perkin Elmer) was equipped with a continuously variable wavelength Model LC-290. Computer integrator Model PE Nelson and a printer EPSON 1050 was also used.

Trans Retinol

C-18 Reverse phase column, 3.9 x 150 mm stainless steel was used for HPLC separation. Mobile Phase, Methanol : water 90 : 10 (v/v). Flow rate 2 ml/min; detector at 325 nm range 0.05 AUFS; pressure 750 psi.

B.Carotene

C-18 Reverse phase column, 3.9 x 150 mm; mobile phase aceto nitrile : dichloromethane: methanol, 70 : 20 : 10 (v/v/v); flow rate, 2 mm/min; detector 450 nm; range 0.05 AUFS; pressure 980 psi.

Quantification of Vitamin A and B.Carotene.

The concentration of vitamin A and B.carotene in ghee samples were determined by using a computer integrator. A software programme was developed which identifies peaks from retention times, and calculate the concentration of vitamin A and ß-carotene in the extract, by comparing the area of the peak of the extracted vitamin A and B.carotene with the peak area of the standard solution of known concentration of vitamin A and B.carotene.

III. **Retention of Vitamin A and ß-carotene in ghee after cooking in deep frying,Shallow frying and during preparation of Curry.**

In deep frying, **potato chips** and a popular snack **pakora** were prepared. While **parata**, **fried egg** and **cutlets** were prepared by shallow frying. Similarly 4 dishes of **potato meat curry** and **daal channa (gram) meat curry**, were prepared. Beside

this a vegetable curry dish of green pea and potato was also prepared. The ghee used in the preparation of these dishes was of the same brand. Samples of ghee before preparation and after preparation of the dishes were collected for determination of vitamin A and ß-carotene. Ingredients and methods of preparation of these snack and dishes is given in Annexure -II.

IV. **Losses of Vitamin A in Ghee at Retailer Shops**

Two small retailer shops were chosen, one each in rural and urban areas near Peshawar. These shops sell ghee from large open tins to people who cannot afford to buy sealed bags or tin and purchase only half or 1 kg ghee from these shops.

A researcher collected a sample of ghee from the beginning, (opening of tin) and at one week interval for a period of 4 weeks for determination of total Vitamin A. A similar experiment was conducted in the lab to check the variation in results. The ghee sample collected was of the same brand and same tin.

RESULTS AND DISCUSSION

Vegetable Ghee Industries in NWFP

Information gathered from Provincial Department of Industries, Peshawar, Pakistan Banaspati Manufacturers Association (PVMA) and visits in the province showed that Ghee Industries are mostly located in district Haripur, Nowshera, Peshawar, Swat and Malakand division. The name of Industry, their annual production and product brand name is given in Annexure -I.

In the Industrial Estate Hattar in district Haripur, there are six factories all in operation. The seventh in Haripur is closed. We found that all six factories in Hattar except one which could not show us the fortificant at the time of our visit use the imported vitamin A fortificant.

In Peshawar and Nowshera districts, there are six factories , out of which one Bara Ghee Mills is in the tribal area of Khyber Agency and we were not allowed to visit. Similarly the management of International Ghee Industries at Hayatabad, Peshawar also did not give us permission to visit their factory. They told us that the factory was closed, though we could get their products in the local market.

In Gadoon Amazai Industrial Estate district Swabi, there are nine factories, out of which, five factories are closed, two are in part time operation while the other two are open and in operation. These two could not show us the fortificant, but claimed the use of it.

In Swat district and Malakand division, there are four factories out of which two are closed while two are open. Out of these two factories, one was using vitamin A fortificant.

Vitamin A and B.Carotene in Banaspati Ghee Samples

Table-1 shows the mean vitamin A (trans retinol), ß-carotene and total vitamin A content in 13 product line and 19 tin samples from all ghee manufacturing units in NWFP, Fig-I. The vitamin A (trans retinol) content of 13 product line and 19 tin samples ranged from 10.3 to 19.3 and 6.6 to 18.5 respectively. The mean value of product line samples is 13.9 and for the tin samples it is 11.6 iu/g. The R.E. from ß-carotene in product line is 3.1 to 8.6 iu/g and in tin sample 4.9 to 9.5 iu/g with a mean level of 6.2 and 7.3 respectively. This value is quite low, thereby showing negligible amount of ß-carotene. Though on the average CPO contain 310 ug/g of ß-carotene or 470 iu/g R.E. from ß-carotene (32). The low value of ß-carotene in all the ghee samples confirmed the earlier findings that almost all ß-carotene is lost during the refining/processing of palm oil (33). As the ß-carotene content is very low, the total vitamin A (Vit. A + RE from ß-carotene) is mostly from added vitamin A fortification. The mean total vitmain A in the product line and in the tin sample is 20.1 and 18.9 iu/g showing that no significant change has occurred in the vitamin A content of tin samples from that of product line samples. One reason for no change in the total vitamin A contents in the tin samples from that of product line sample may be due to the finding that Vit. A in Oil remains stable in sealed tin/containers for about six months (28) and also that the samples were analyzed immediately after opening the sealed tin.

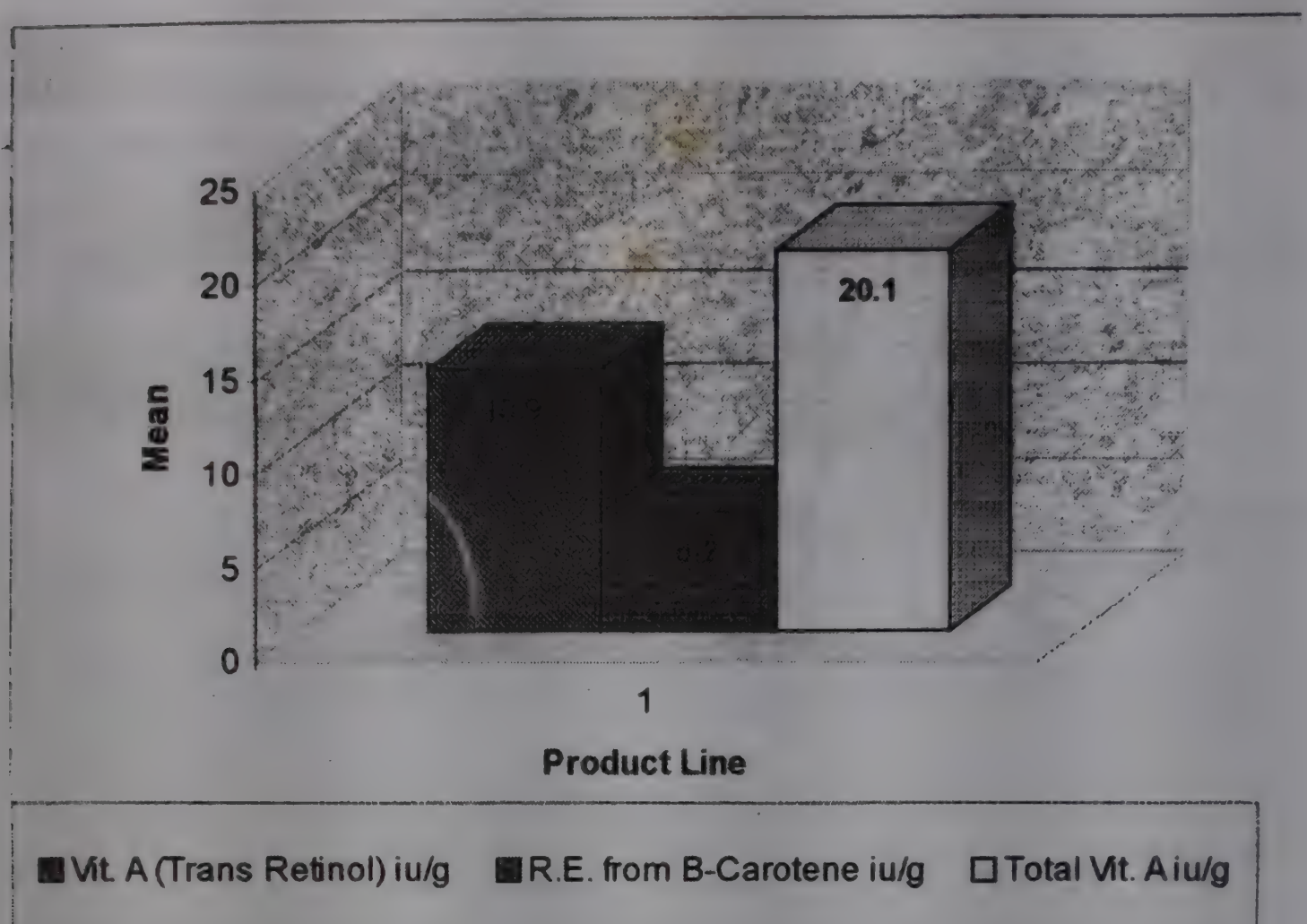
Table-1

MEAN VITAMIN A (TRANS RETINOL), R.E FROM ß-carotene AND TOTAL VITAMIN A IN BANASPATI GHEE SAMPLES

Samples	N	Min (iu/g)	Max (iu/g)	Mean ± S.D
Vitamin A (Trans Retinol) (P.L)	13	10.3	19.3	13.9 ± 3.4
R.E from B.carotene (P.L)	13	3.1	8.6	6.2 ± 1.6
Total vitamin A (Trans retinol + R.E from ß-carotene) (P.L)	13	13.4	26.8	20.1 ± 4.5
Vitamin A (Trans Retinol) (Tin)	19	6.6	18.5	11.6 ± 3.6
R.E from B.carotene (Tin)	19	4.9	9.5	7.3 ± 1.3
Total vitamin A (trans retinol + R.E from ß-carotene) (Tin)	19	13.5	27.9	18.9 ± 4.3

P.L. = Product Line samples
Tin = Tin samples
N = Number of samples
SD = Standard Deviation

Figure 1: Mean Vitamin A (Trans Retinol), R.E. From B-Carotene and total Vitamin A in Banaspati Ghee Sample.



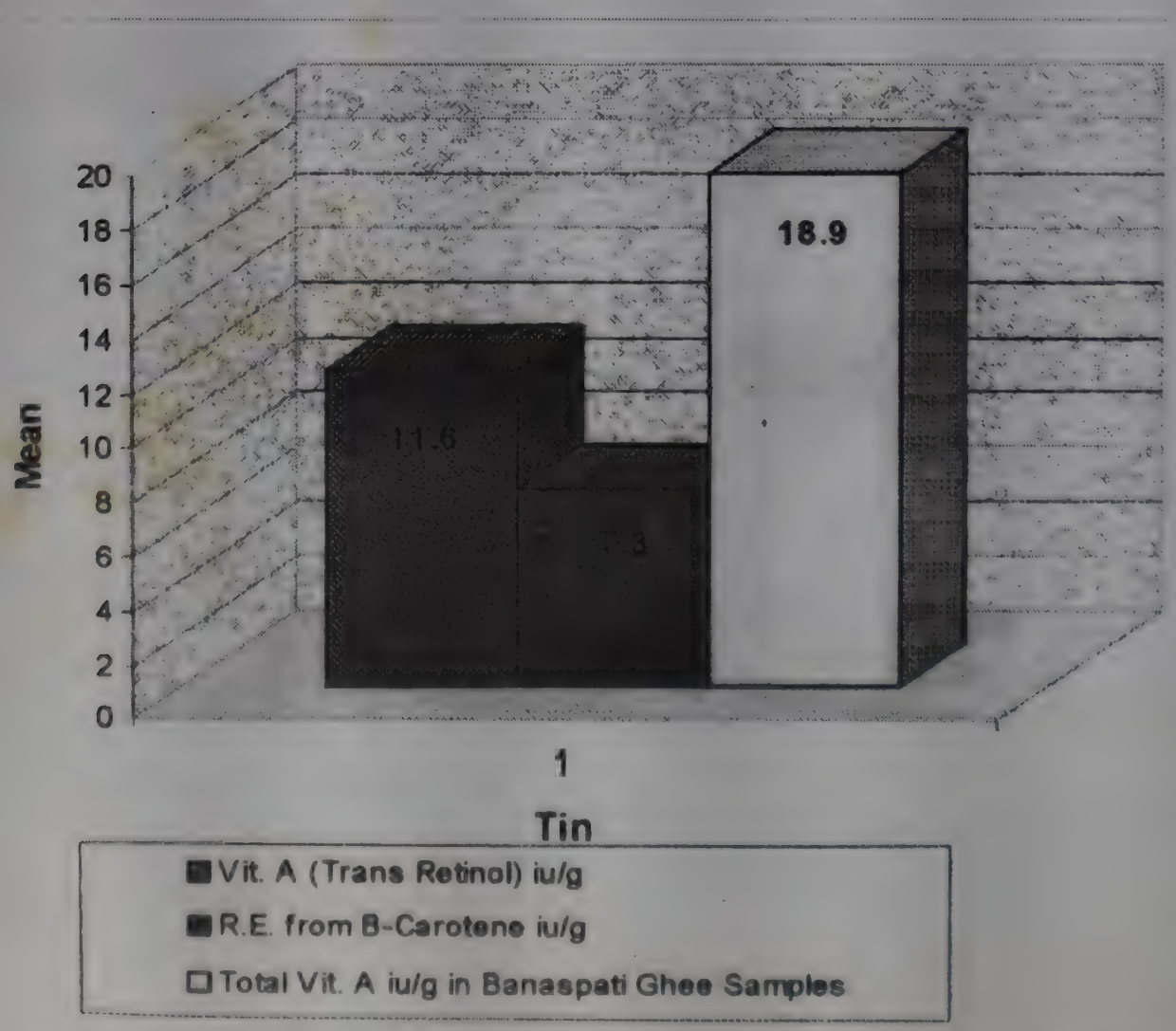


Table-2 shows the percent vitamin A (trans retinol) and percent total vitamin A (trans retinol + RE from ß-carotene) in the product line and in the tin samples of banaspati ghee, Fig-II. The result indicate that 69% of the product line and 84% of the tin samples had less than 50% of vitamin A (trans retinol). While 38% of the product line and 42% of the tin samples had less than 50% of total vitmain A content (trans retinol + RE from ß-carotene). Even after including RE from ß-carotene which is already present in vegetable oil, none of the samples contain the required level of vitamin A fortificant.

Potency of vitamin A Fortificant

The sample of vitamin A fortificant collected from various ghee manufacturing units in NWFP, were analyzed for their vitamin A content and percent Vitamin A retention in the fortificant as compared to the labelled values. The results given in Table - 3 show that none of the 12 samples of vitamin A fortificant had 100% potency (Fig.III). The fortificant used in the 4 units out of 6 at Hattar and 1 out of 3 at Peshawar and Nowshera had 90 to 94% vitamin A as compared to the labelled value. While no sample of fortificant from Gadoon and Dargai had upto 90% vitamin A potency. The vitamin A fortificant available with the factories is from two sources, one a German Product and other an Italian Product. It is available in 1 Kg, 5 Kg, and 10 Kg tins. The Price is about Rs. 5000/- per Kg. The fortificant is procured by the Ghee factories through a dealer in Karachi.

Table-2

PERCENT VITAMIN A (TRANS RETINOL), AND PERCENT TOTAL VITAMIN A IN BANASPATI GHEE SAMPLES

Samples	N	Min (iu/g)	Max (iu/g)	Less than 50% of added vit.A
Percent vitamin A (Trans Retinol) (P.L)	13	31.2	58.7	69.2
Percent vitamin A. (Trans retinol) (Tin)	19	20.1	56.0	84.2
Percent total vitamin A (Trans Retinol + R.E from ß-carotene) (P.L)	13	40.5	81.2	38.4
Percent total vitamin A (trans retinol + R.E from B.carotene)(Tin)	19	41.0	84.6	42.0

P.L. = Product Line samples
Tin = Tin samples
N = Number of samples

Figure 2: Percent Vitamin A and Percent Total Vitamin A in Banaspati Ghee Samples.

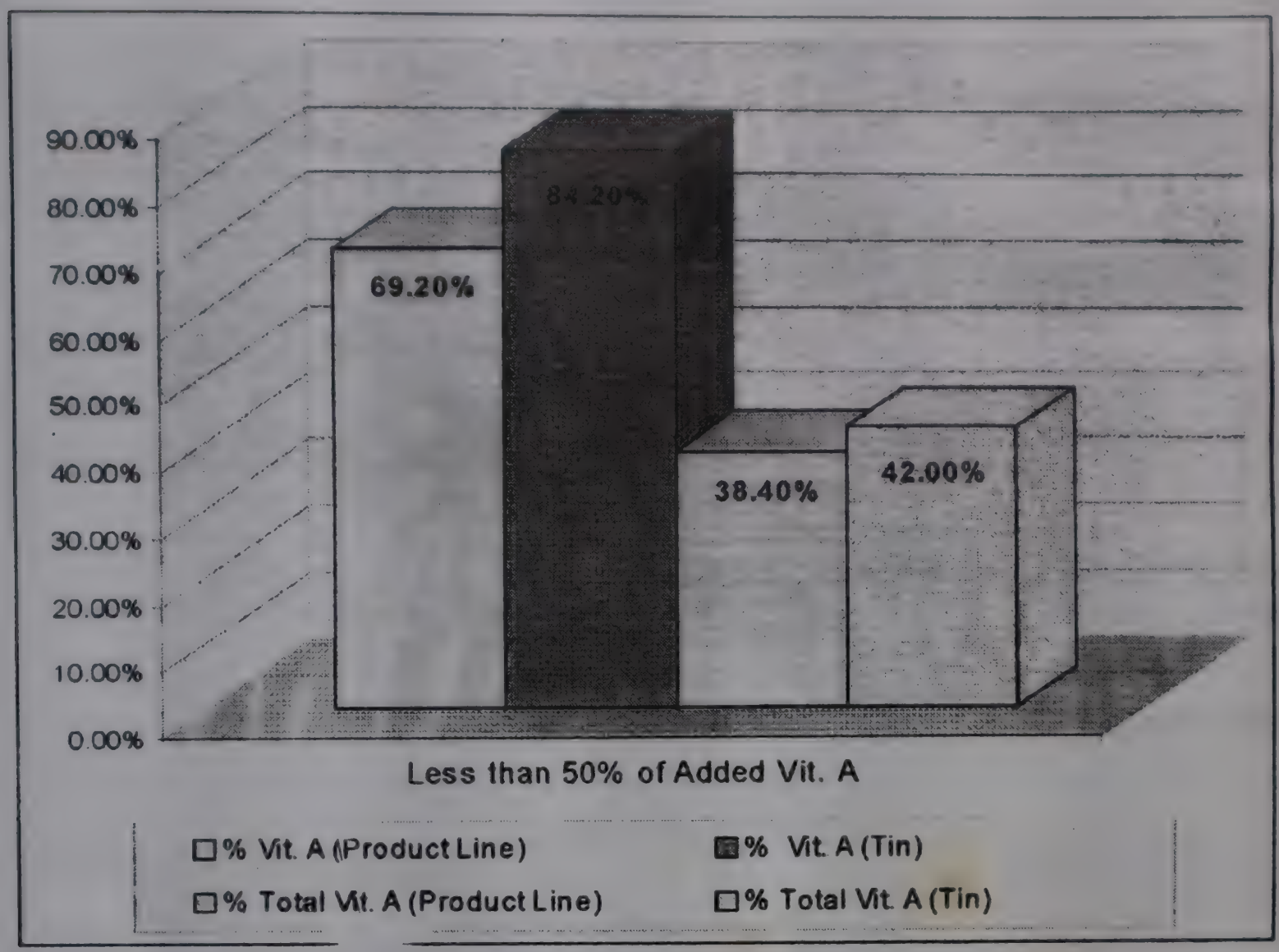


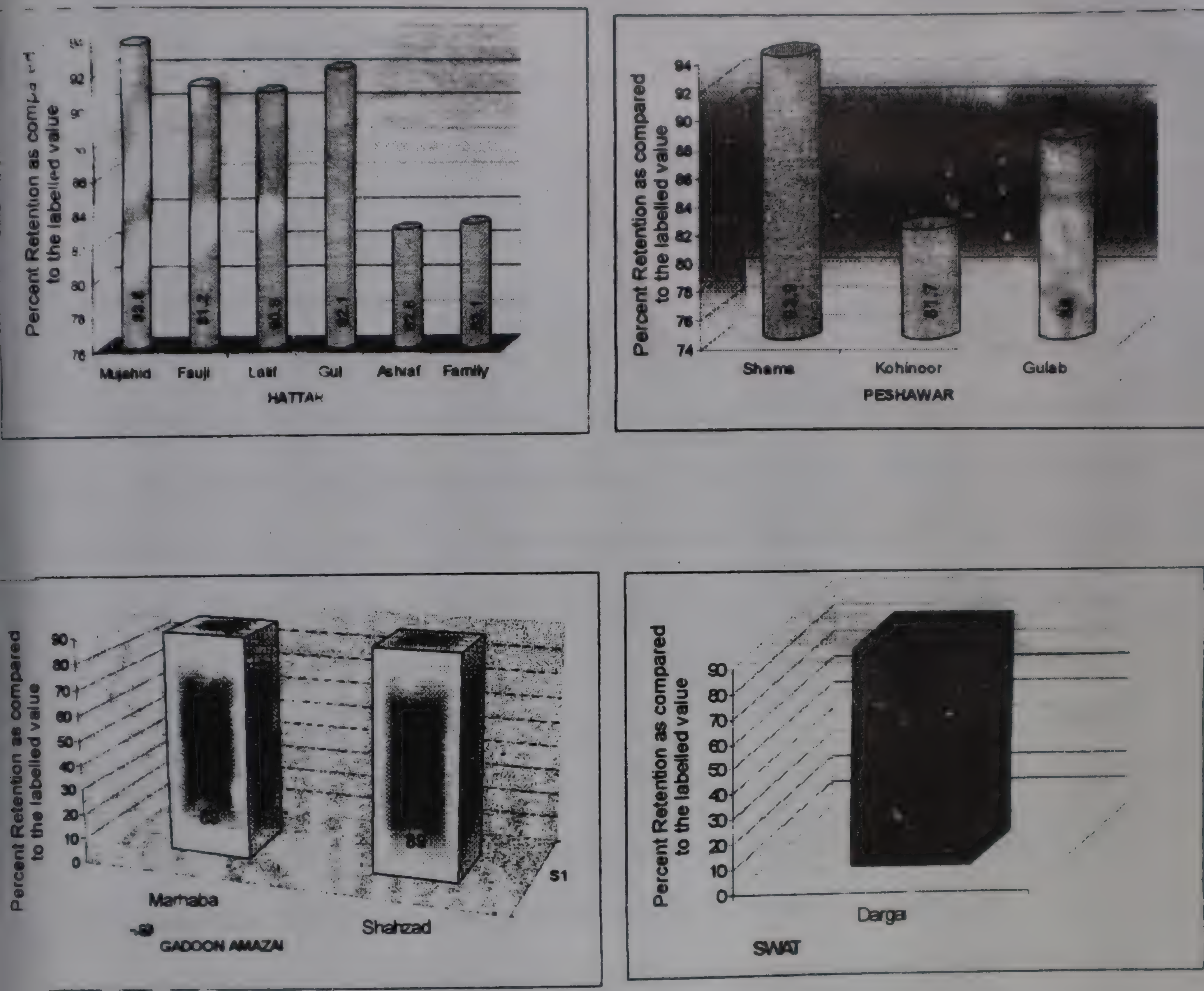
Table-3

PERCENT RETENTION IN VITAMIN A FORTIFICANT
AS COMPARED TO THE LABELLED VALUE *

Name of the factory	Brand Name of ghee	percent retention as compared to labelled value
Hattar		
Hafeez Iqbal Oil & Ghee Mills	Mujahid	93.6
Waheed Hafeez Ghee Mills	Fauji	91.1
Latif Ghee Industires	Latif	90.8
Chiniot Enterprises	Gul	92.1
Hassnain Dawood Oil & Ghee Industries	Ashraf	82.7
Pan-Asia Products (Pvt.) Ltd.	Family	83.1
Peshawar		
Associated Industires Ltd.	Shama	93.8
Ashraf Industries	Kohialnoor	81.7
Bilour Industries (Ltd.)	Gulab	88.0
Gadoon Amazai		
Tor-Dher Vegetable Ghee Mills	Marhab	89.4
Shahzad Ghee Mills	Shahzad	89.1
Gul Cooking Oil & Vegetable Ghee Mills	Dargai	87.2

Labelled value: 1008, MIU/kg

Figure 3 : Percentage Retention in Vitamin A fortificant as compared to the labelled value (90% - 94%)



Labe o V. ue = 00i M iu / kg

Typical Pakistani Dishes

The ingredients and method of preparation of some popular snacks using deep and shallow frying and curry dishes is given in annexure-II.

Retention of Total Vitamin A during deep and shallow frying
Deep Frying

Potato Chips

Table-4 shows the retention of total vitamin A (added vitamin A + RE from ß-carotene) in the oil used for potato chips and pakora. In the ghee used for potato chips it was observed that the retention of total vit. A was 80.3, 63.5 and 40.7% after Ist, 2nd and 3rd frying, Fig-IV. A study revealed that 58 % of vit. A was retained after 4 repeated frying of potato. It is to be noted that left over oil is not sufficient for use after 3rd frying. Moreover repeated heating of oil results in oxidation of it components and their fragmentation to various compounds, which alters the chemicals, physical and organoleptic properties of oil (28).

Pakora:

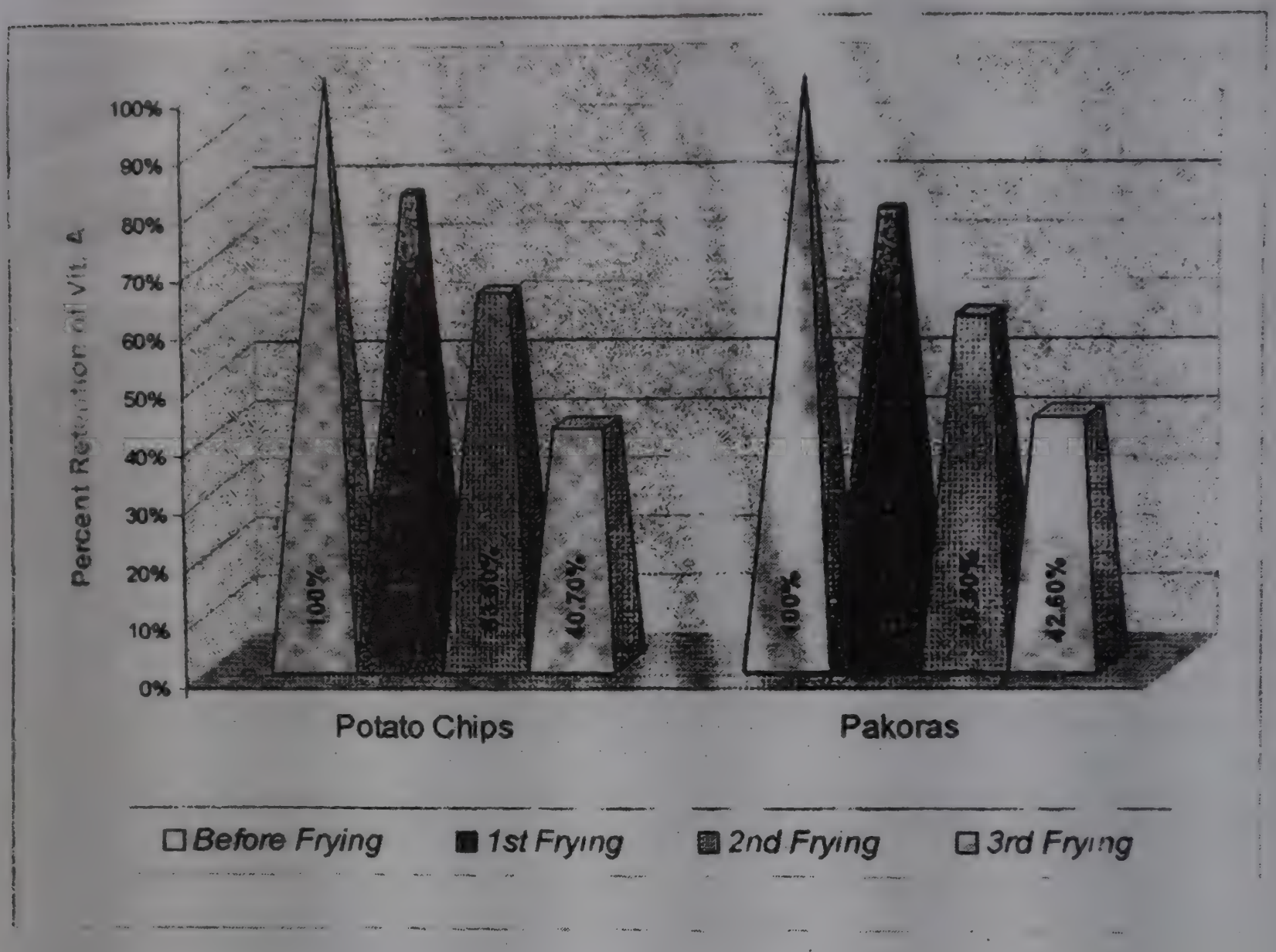
In pakora cooking 77.2, 59.5 and 42.6% of total vit. A was retained in the ghee after Ist, 2nd and 3rd frying. As the cooking time of the chips and pakora is almost the same, the percent retention of vitamin A in the oil after 3rd frying was also about the same. It shows that heat and cooking time has a marked effect on the retention of Vit. A.

Table-4

PERCENT RETENTION OF TOTAL VITAMIN A OF GHEE SAMPLE IN DEEP FRYING

Ghee Sample (Shama)	Vit. A iu/g	R.E. from B.Carotene iu/g	Total Vit.A iu/g	Percent retention of total Vit.A
A. Potato chips				
Cooking time for one frying (30 min.)				
Ghee, before frying	17.3	9.1	26.4	100
After lst frying	14.3	6.9	21.2	80.3
After 2nd frying	12.0	4.7	16.7	63.5
After 3rd frying	7.9	2.8	10.7	40.7
B. Pakoras: Cooking time for one frying (40 min.)				
Ghee before frying	17.3	9.1	26.4	100
After lst frying	15.0	5.4	20.4	77.2
After 2nd frying	11.2	4.5	15.7	59.5
After 3rd frying	8.2	3.0	11.3	42.6

Figure 4 : Percent Retention of Total Vitamin A of Ghee samples in Deep Frying.



Shallow Frying

Retention of vitamin A in the ghee used in shallow frying is given in table-5. Parata, fried egg and cutlet were taken as examples of shallow frying. Moreover parata and fried eggs are generally eaten by majority of the peoples in breakfast, while cutlet is used as snack. The percent retention of total vitamin A in the ghee used in cooking of parata, fried egg and cutlet was found to be 80, 88 and 72% respectively. The more retention of vitamin A in shallow frying as compared to deep frying may be due to heating the oil for less time (5-20 minutes) for the 3 shallow fried items as compared to potato chips and pakora in deep frying which took about 30 minutes, Fig-V.

The results also indicate that in fried egg which was cooked in 5 minutes, the vitamin A retention was 88%. In parata the oil was heated for 10 minutes , the vitamin A retention was 80% , while in a cutlet, it was 72% as the oil was used for more time (30 minutes).

Retention of Vitamin A in Curry Making

The retention of total vitamin A in the oil used in curry making is given in table-6. In the 3 curry dishes, **potato meat curry, daal channa meat curry and pea potato curry**, the percent retention of total vitamin A was 57.7, 54.0 and 62.0%, Fig-VI. This data shows that heating oil for longer time reduces the vitamin A content. Comparing the 3 curry dishes, **pea potato curry** dish which was cooked for 1 hour had more vitamin A retained 62% as compared to **potato meat curry** 57.7 % and **daal channa**

meat curry 54.0 % cooked for 1 ½ hour. These observations are in conformity with another study which showed that vit. A content of oil decreased with increase in heating time used in the preparation of dishes (26).

Table-5

PERCENT RETENTION OF TOTAL VITAMIN A OF GHEE SAMPLE IN SHALLOW FRYING

Ghee Sample (Shama)	Vit. A iu/g	R.E. from B.Carotene iu/g	Total Vit.A iu/g	Percent retention of total Vit.A
A. Parata				
Cooking time(10 min.)				
Ghee before frying	17.3	9.1	26.4	100
After frying	15.1	6.0	21.1	80
B. Fried Egg				
Cooking time (5 min.)				
Ghee before frying	17.3	9.1	26.4	100
After frying	16.0	7.2	23.2	88
C. Cutlets:				
Cooking time (30 min.)				
Ghee before frying	17.3	9.1	26.4	100
After frying	14.8	4.2	19.0	72

Figure 5 : Percent Retention of Total Vitamin A of Ghee samples in Shallow Frying.

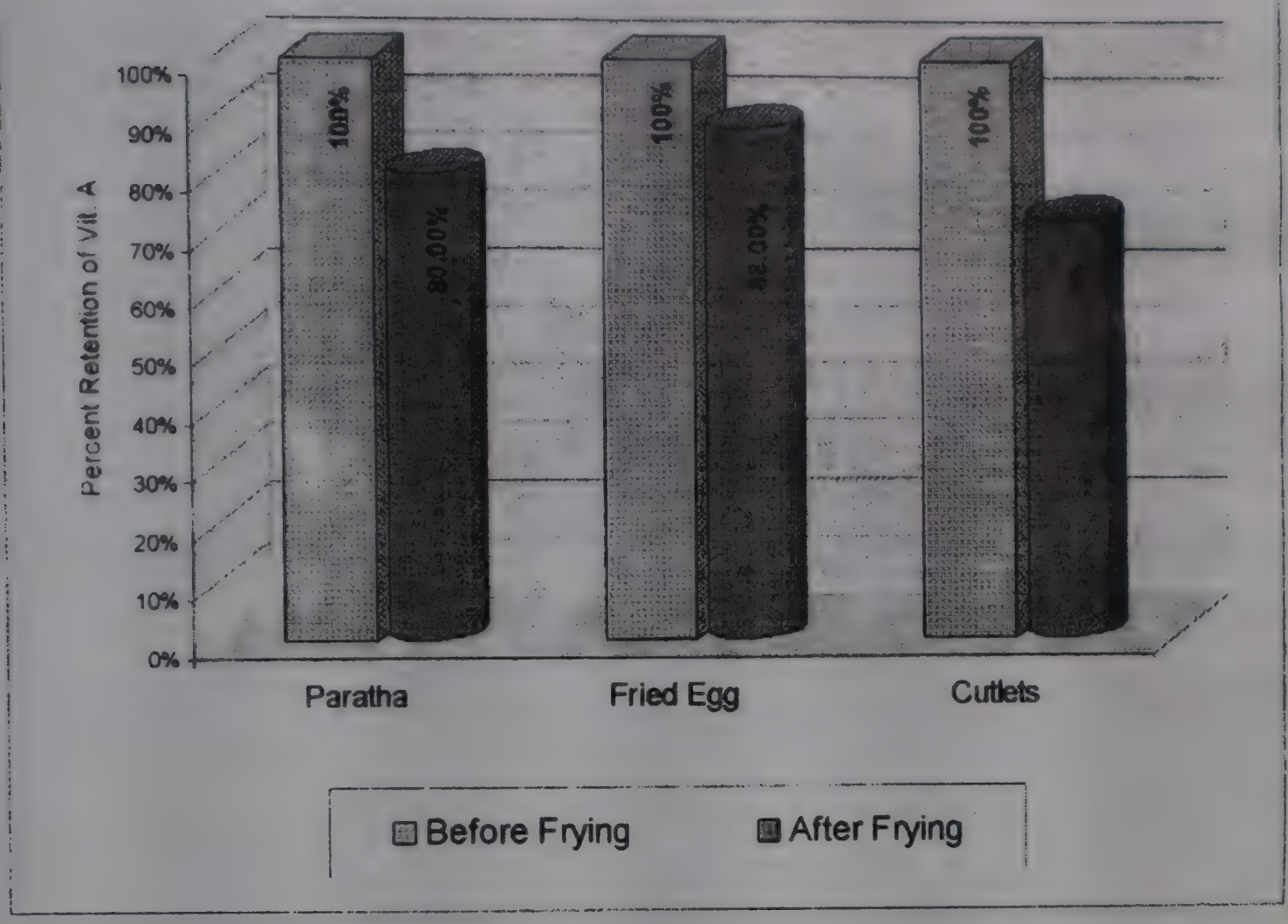
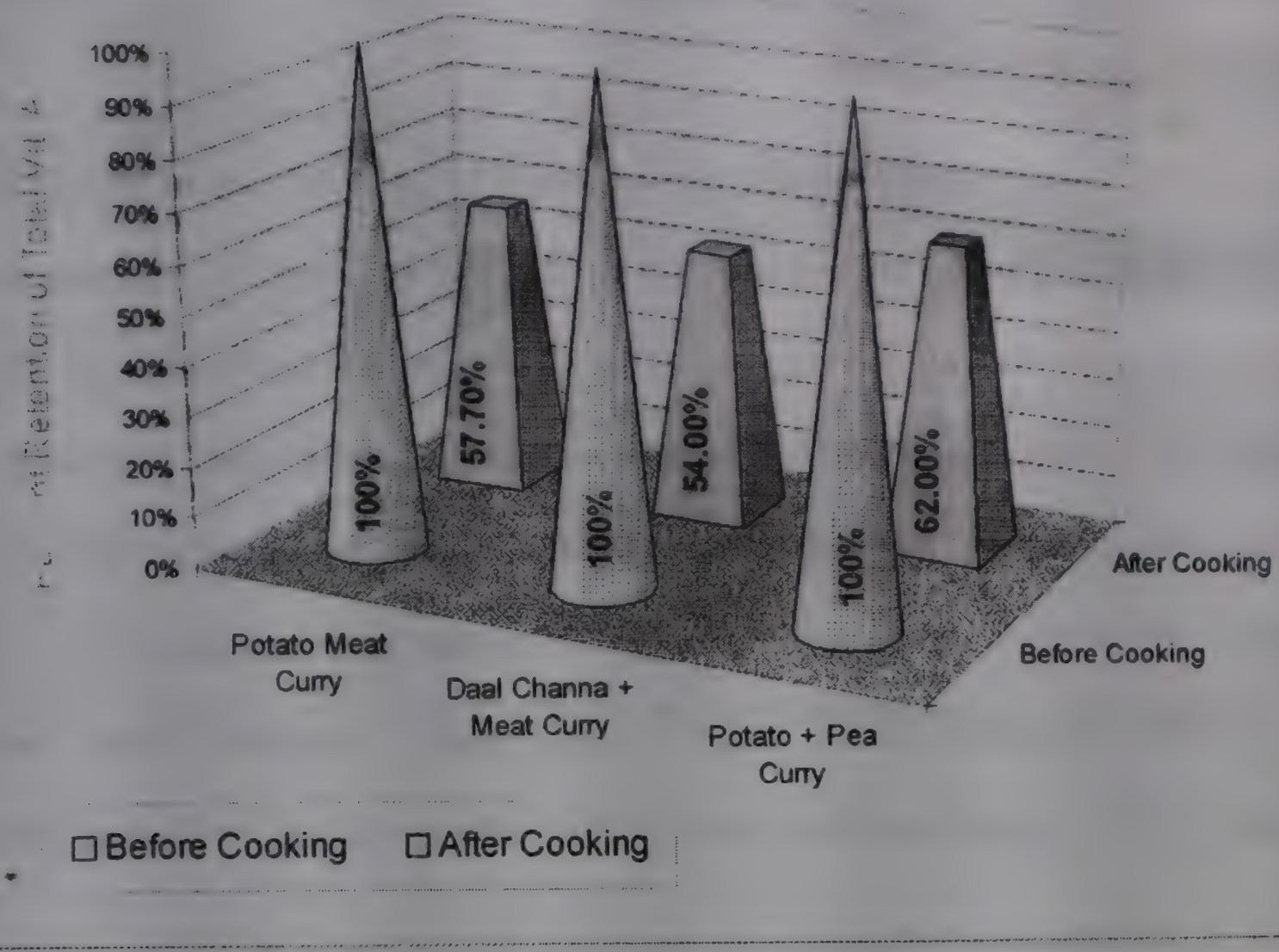


Table-6 PERCENT RETENTION OF TOTAL VITAMIN A OF GHEE SAMPLE IN CURRY MAKING

Ghee Sample (Shama)	Vit. A iu/g	R.E. from B.Carotene iu/g	Total Vit.A iu/g	Percent retention of total Vit.A
A. Potato Meat Curry Cooking time 1 ½ h				
Ghee before cooking	17.3	9.1	26.4	100
After cooking	11.2	4.0	15.2	57.7
B. Daal Channa (gram) Meat Curry Cooking time 1 ½ h				
Ghee before cooking	17.3	9.1	26.4	100
After cooking	10.7	3.6	14.2	54.0
C. Pea, Potato Curry Cooking time: 1 h				
Ghee before cooking	17.3	9.1	26.4	100
After cooking	12.1	4.2	16.4	62.0

Figure 6 : Percent Retention of Total Vitamin A of Ghee samples in Curry Making.



These results also indicate that more than 50% of the vitamin A is retained even after 1 ½ hour cooking which is the normal time of cooking for the 3 traditional dishes.

Losses of Vitamin A at Retailer Shop

Percent losses in total vitamin A in ghee exposed to light and air at the retailer shop is given in table-7. The result indicate 20.3, 31.1, 43.5 and 49.7% losses in total vitamin A in the ghee sample exposed to light, air in open 16 kg tin after lst, 2nd, 3rd and 4th week at retailer shop, Fig-VII . Similar results have also been observed by Scita 1992, who reported rapid degradation of Vitamin A in oil exposed to ultraviolet and visible light in presence of atmospheric oxygen. Another study showed 30 % loss in Vitamin A in CSB exposed for 30 days in open pails. However, there were minumum losses in Vit. A fortified oil as long as the pails remained unopened (26).

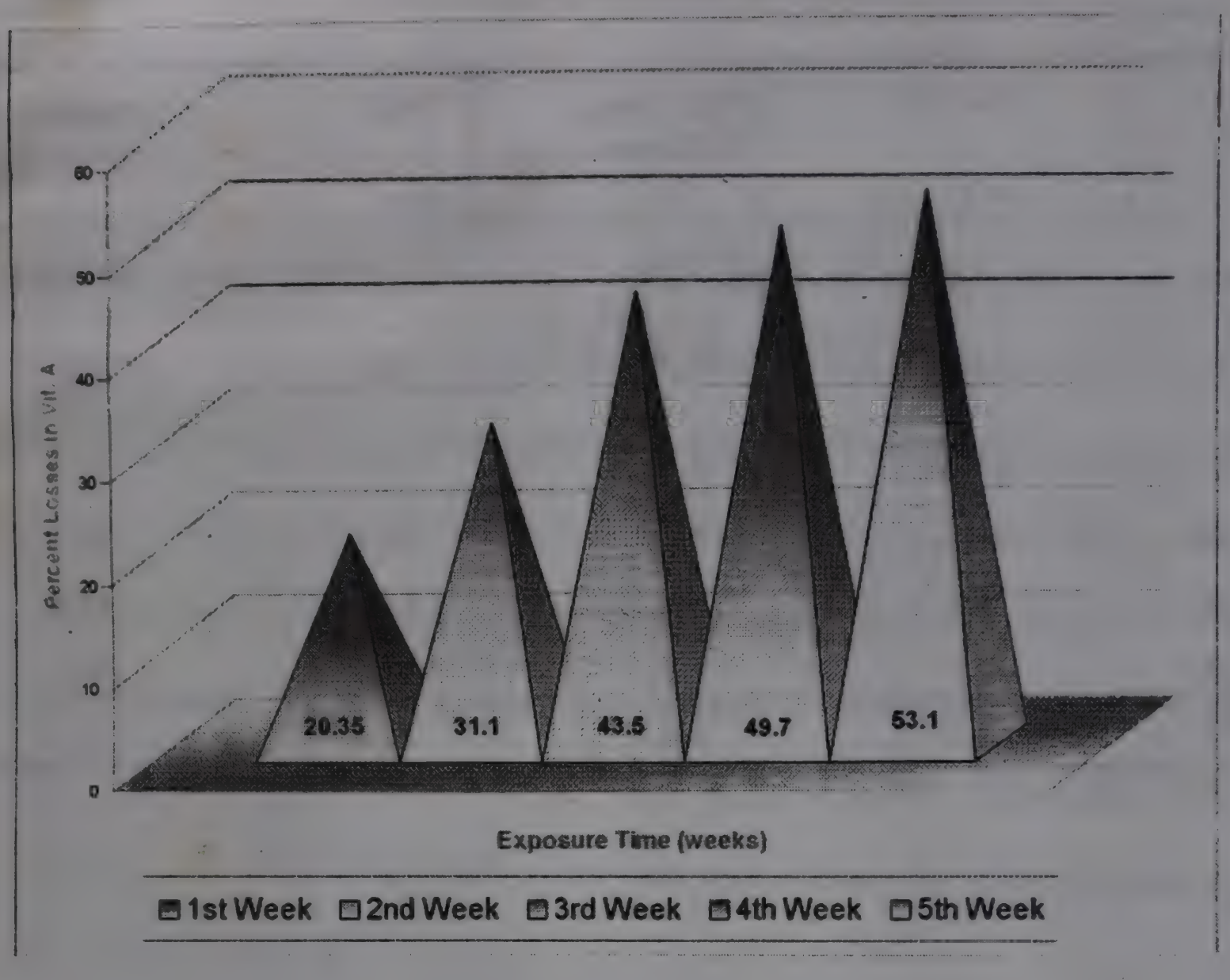
However, it is to be noted that ghee in the large tin at retailer shop in rural area finishes in 2-3 weeks. But if it was kept even for 4 weeks it still contain 50% of total vitamin A.

Table-7

PERCENT LOSSES IN TOTAL VITAMIN A OF GHEE EXPOSED TO LIGHT AND AIR AT RETAILER'S SHOP

Ghee Sample (Shama)	Vit. A iu/g	R.E. from B.Carotene iu/g	Total Vit.A iu/g	Percent Losses in total Vit.A
Immediately after opening the Tin	17.6	9.2	26.8	100
After 1st week	13.9	7.4	21.4	20.3
After 2nd week	12.1	6.4	18.5	31.1
After 3rd week	9.4	5.8	15.1	43.5
After 4th week	8.8	4.7	13.5	49.7
After 5th week	8.1	4.4	12.6	53.1

Figure 7 : Percent losses of Vitamin A in Ghee samples exposed to Light and Air at Retailer Shop.



MAIN FINDING

1. Vegetable oil/ghee is a suitable vehicle for vitamin A fortification
2. The consumption of vegetable ghee is increasing in Pakistan.
3. Crude palm oil is a rich source of ß-carotene, a precursor of vitamin A.
4. Processing/refining of crude palm oil results is significant loss of ß-carotene.
5. ß-carotene level in the ghee samples analysed is quite low, confirming that most of the ß-carotene is lost during processing.
6. According to Pure Food Law of Pakistan, it is mandatory on manufacturers to add 9.9 ug/g or 33 iu/g of vitamin A (Trans retinol) in the ghee and oil.
7. The results of this study show that none of the ghee sample had the required level of vitamin A fortification.
8. No significant change was found in the vitamin A content of the ghee in the tin samples from that of the product line samples, indicating no loss of vitamin A in the tin sample as compared to the product line samples.
9. The results indicate that 38% of the product line and 42% of the tin samples of ghee had less than 50% of total vitamin A content (Trans retinol + RE from ß-carotene) as compared to the required level of fortification.
10. None of the vitamin A fortificant used by the 12 ghee manufacturing units had 100% vitamin A as compared to the labelled value.
11. In repeated deep frying upto 60%, in shallow frying 30% while in curry making 50% of total vitamin A is lost.
12. Vitamin A and ß-carotene is affected by light, air, moisture and it was observed that 50% of total vitamin A is lost during 4 weeks in open ghee tins exposed to light and air.

RECOMMENDATION

1. All vegetable ghee brands should be registered.
2. Proper level for vitamin A fortification as given in Pure Food Law, 1965 be enforced through government or Pakistan Vanaspati Manufacturers Association (P.V.M.A).
3. Those manufacturers whose products have the required level of vitamin A be given a certificate of achievement by the government and a seal of quality be placed on their product.
4. Each factory must have a quality control lab with proper instruments and headed by a qualified chemist.
5. A standard analytical test, but less costly be devised for vitamin A determination.
6. The product of the various ghee manufacturing units be periodically checked for vitamin A content in a reference laboratory.
7. One reference laboratory be established in each province. The experts from the reference lab should visit the factories once in 3 months interval for collection of samples and monitoring of quality.
8. P.V.M.A may procure vitamin A fortificant directly from abroad instead of each industrial unit getting it through private dealers.
9. Methods be devised for processing/refining and mixing of fortificant with oil so that there is less loss of ß-carotene in crude palm oil.

10. The fortificant should immediately be used after opening the tin. It should not be kept with open lid exposed to light and air. After use the fortificant be stored in dark and cold condition.

11. The tin or bottle of banaspati ghee or oil should have a lid which could be tightly closed after each use and the use of transperent bottles for oil be curtailed.

12. People should be informed through media that repeated deep frying in the same oil/ghee would destroy most of vitamin A and be avoided.

13. P.V.M.A should plan annual workshop to monitor the vitamin A fortificaiton programme. A top government functionary should give a certificate of achievement to those manufacturers who have the required level of vitamin A fortificant in their products.

REFERENCES

1. Sommer A. (1989). New imperatives for an old vitamin (A). J. Nutr. 119. 96-100.

2. Chandra, R.K. Vyas D. (1989). Vitamin A, immunocompetence, and infection. Food Nutr. Bull, 11 (3): 12-19.

3. Sommer, A., Katz, J. Tarwotji, I. (1984). Increased risk of respiratory diseases and diarrhea in children with preexisting mild vitamin A deficiency. Am. J. Clin. Nutr. 40: 1090-95.

4. McLaren D.S. (1986). Global occurrence of vitamin A deficiency in Bauerfiend J.C, ed. Vitamin A deficiency and its control. Orlando, Fla, USA, Academic Press, 1-18.

5. Cohen, N. Rahman, H. Mitra M. et al (1987). Impact of massive doses of vitamin A on nutritional blindness in Bangladesh. Am. Clin. Nutr. 45: 970-76.

6. Pereira S.M, Begum A. (1976). Vitamin A deficiency in Indian children. World Rev. Nutr. Diet 24: 192-216.

7. Bergen, H.R. Natadisastra, G. Muhilal, H. Dedi, A. Karyadi, D. Olson, J.A. (1988). Vitamin A and vitamin E status of rural preschool children in West Java, Indonesia, an their responses to oral doses of vitamin A and vitamin E. Am. J. Clin. Nutr. 48: 279-85.

8. West K.P. Pokhrel, R.P. Katz, J. et al (1991). Efficiency of vitamin A in reducing preschool child. Mortality in Nepal. Lancet 338: 67-71.

9. Bloem, M.W. Wdel, M. Egger, R.J. et al (1990). Mild vitamin A deficiency risk of respiratory tract infection an diarrhea in preschool and school children in Northeastern Thailand. Am. J. Epidem 131 (2): 332-39.

10. Simmon, W.K. (1976). Study on Hypo vitaminosis A in Brazil and other Latin American countries. Ecol. Food and Nutr. 51-55.

11. Micro Nutrient Survey of Pakistan (1976). Nutrition Cell, Planning and Development Division, Government of Pakistan, Islamabad.

12. Paracha, P.I., Hameed, A., Simon, J., Jamil. A., Nawab, H. (1997). Prevelance of anemia in semi urban areas of Peshawar, Pakistan. A chellange for Health Professionals and Policy maker. J. Pak. Med. Assoc. 47: 49-53.

13. NIH (1988). National Nutrition Survey 1985-87 report. Nurition Division, National Institute of Health, GOP.

14. National Nutritional Survey of Pakistan (1985-87). Draft Report. National Institute of Health, Islamabad.

15. Federal Board of Statistic. HIES (1984-1985) to (1990-91). Statistic Division, Govt. of Pakistan, Islamabad.

16. Olson J.A. (1990). Vitamin A In: Brown ML et al; eds. Present knowledge in nutrition 6th ed. Washington, D.C. Intrnational Life Sciences Institute, Nutrition Foundation, 96-107.

17. Olson, J.A. (1987). Recommended dietary intakes (RDI) of vitmain A in humans. Am. J. Clin. Nutr. 45: 704-716.

18. Simpson K.L, Tsou, S.C.S. (1986). vitamin A and provitamin A composition of foods In: Bauerfeind. Jc, ed. vitamin A deficiency and its control. Orlando, Fla. USA Academic Press, 1986; 461-78.

19. IVACG (1989). Guideline for development of a simplified dietary assessment to identify group at risk for inadequate intake of vitamin A. Washington D.C. International Life Science Institute.

20. Margarine Regulation (1967). Statuary Instrument No.167 as amended. London H.M. Stationary Office London, U.K.

21. Tajammal Hussain, Mushtaq A. Khan, (1993). vitamin A conent in Banaspati Ghee and oil produced in Pakistan. A report submitted to P&D, GOP, Islamabad, UNICEF, Faculty of Nut. Sci. NWFP AUP.

22. Delia B. Rodriguez. Amaya (1996). Assessment of provitamin A contents of Foods. The Brazilian Experience. J. Food compositioin and analysis 9, 196-230.

23. Rahman, M.M. Waheed M.A. Akbar Ali M. (1990). Beta-carotene losses during defferent methos of cooking of green leafy vegetables in Bangladesh. J. Food Comp. Anal. 3: 47-53.

24. Sweeney J.P., Marsh, A.C. (1971). Effect of procesing on provitamin A in vegetables. J. Am. Diet. Assoc. 59: 238-43.

25. Burt, J. (1988). Fish Smoking and drying, New York. Elsevier Science Publishers.

26. Atwod, S.J., Sanghva, T.G. et al (1995). Stability of vitamin A in fortified vegetable oil and corn soy Blend used in child feeding programs in India. J. Food comp. and Analysis 8, 32-44.

27. Fortification Basics (1996). Oil and margarine. A publication of OMNI, Roche, and USAID.

28. Favaro, M.D.R., Ferreria J.F. et al (1991). Studies on fortification of refined soybean oil with all-trans retinyl palmitate in Brazil. Stability during cooking and storage. J. Food Comp. and analysis. 4, 237-244.

29. Bueno, M.P. (1997). Collaborative study: determination of retinol and carotene by High-performance liquid Chromatography. Food Chem. (Submitted).

30. Rader J.I., Weaver, C.M. et al (1997). -Tocopherol, total vitamin A and total fat in margarines and margarine like products. Food Chem. 58: 4, 373-379.

31. Speek, A.K., Schrijuer, J. and Schreurs, W.H.P. (1985). Vitamin E composition of some seed oils as determined by high performance liquid chromatography with flourometric detection. J. Food Sci. 50, 121-124.

32. Bagepalli, S, Rao, N. (1994). Palm oil use and compatability in India. Food and Nutr. Bulletin, 15: 2.

33. Manorama R. and Rukmini, C. (1991). Effect of Processing on ß-carotene retention in crude palm oil and its products. Food Chemistry 42: 253-264.

Annexure-I

VEGETABLE GHEE INDUSTRIES IN NWFP

INDUSTRIAL ESTATE HATTAR (DISTT. HARIPUR)

1. Chiniot Enterprises (Pvt.) Ltd.
2. Latif Ghee Industries (Pvt.) Ltd.
3. Pan Asia Food (Pvt.) Ltd.
4. Hafeez Iqbal Oil and Ghee Industries (Pvt.) Ltd.
5. Hasnain Dawood Oil and Ghee Mills Ltd.
6. Waheed Hafeez Industries (Pvt) Ltd.
7. Yakta Ghee Mills. (Closed)

Name of the Industry	Production per year M.Ton	Oil Palm+Cotton Soybean	Product/Brand name
Chiniot Enterprises	48,000	70 - 30	Gul
Latif Ghee Industries	72,000	60 - 40	Super Latif
Pan Asia Food	15,000/ 20,000	75 - 25	Family
Hafeez Iqbal Oil & Ghee Industries	70,000	65 - 35	Mujahid
Hussnain Dawood Oil & Ghee Industries	10,000	70 - 30	Ashraf/Kohialnoor
Waheed Hafeez Industries	80,000/ 90,000	65 - 35	Fauji/Phool

INDUSTRIAL ESTATE HAYATABAD, NASIRPUR AND NOWSHERA (DISTT PESHAWAR AND NOWSHERA)

1.	Bilour Ghee Industries,	-	Haytabad, Peshawar
2.	Imala Ghee Industries,	-	Hayatabad, Peshawar
3.	Ashraf Ghee Industries,	-	Nasirpur, Peshawar
4.	Bara Ghee Mills,	-	Bara, Khyber Agency
5.	International Ghee Industries,	-	Hayatabad (Closed)
6.	Associated Industries,	-	Nowshera

Name of the Industry	Production per year M.Ton	Oil Palm+Cotton Soybean	Product/Brand name
Bilour Ghee industries	100,000	100% Palm	Gulab
Imala Ghee Industires	12,000	70 - 30	Sehat
Ashraf Ghee Industries	12,000	50 - 50	Suman, Kohialnoor
Bara Ghee Industries	-	-	Bara
International Ghee Industries	-	-	Kanwal
Associated Industries	50,000	70 - 30	Shama

INDUSTRIAL ESTATE GADOON AMAZAI (DISTRICT SWABI)

1. Shahzad Ghee Industries
2. Tor Dher Vegetable Ghee Industries
3. Kaghan Ghee Mills Ltd.
4. Utman Ghee Mills Ltd.
5. Afghan Ghee Mills, (Closed)
6. Nawaz Ghee Mills, (Closed)
7. Khyber Agro Ghee Mills, (Closed)
8. Sarhad Ghee Mills, (Closed)
9. Marhaba Ghee Mills, (Closed)

Name of the Industry	Production per year M.Ton	Oil Palm+Cotton Soybean	Product/Brand name
Shahzad Ghee Industries	20,000/ 30,000	80 - 20	Shahzad
Tor Dher Industries	30,000/ 40,000	100% Palm	Marhaba
Kaghan Ghee Mills	36,000	80 - 20	Kohitoor
Utman Ghee Mills	-	-	Tawana

DISTRICT SWAT AND MALAKAND DIVISION

1. Gul Oil and Ghee Mills, - Dargai
2. Malakand Ghee Mills Ltd. - Thana
3. Allied Ghee Mills, - Thana (Closed)
4. K.J. Ghee Mills, - Dargai (Closed)

Name of the Industry	Production per year M.Ton	Oil Palm+Cotton Soybean	Product/Brand name
Gul Oil & Ghee Mills	14,000/ 16,000	80 - 20	Dargai
Malakand Ghee Mills	10,000	100%	Zorawar

Annexure-II

TYPICAL PAKISTANI COOKING METHODS

1. DEEP FRYING

a) **Potato Chips:**

Ingredients:

1) Potatoes
2) Ghee
3) Salt and Pepper

Method:

Peel and slice potatoes. Heat ghee in a deep frying pan. Put sliced potatoes in it and cook for 15-20 minutes until golden and crisp. Take the chips out on an absorbent paper and put salt and pepper on it. This ghee can be used again for frying.

Cooking Time: 30 minutes.

b) **Pakoras:**

Ingredients:

1) Basin (Powdered gram) 250 gm
2) Onions, 2 medium size (Pealed and shredded)
3) Green chillies 3-4 (cut into small pieces)
4) Potatoes 2 medium size (Peeled and finely cut into small pieces)
5) Corriander leaves. ½ cup
6) Salt 1½ teaspoon/according to taste
7) Red Chillies powder. 1½ teaspoon
8) Corriander powder. 1 teaspoon
9) Ghee. 500 gm
10) Cumin seeds. 1 teaspoon

Method:

Put all the ingredients together in a bowl and make a paste with the help of water. Heat ghee in a deep frying pan. When ghee become hot put small quantities of paste in ghee with the help of spoon. Fry them until golden brown. Take it on an absorbent paper. The ghee in this method can also be used again for another frying.

Cooking time: 30 - 40 minutes

2. SHALLOW FRYING

In this type of frying small amounts of ghee is taken in a frying pan so that the lower portion of food is cooked first. then food is turned back so that the other side is cooked. For e.g.

a) **Parata:**
Ingredients:

1) Wheat flour: Make dough of wheat flour with the help of small amount of water and add some salt in it.

2) **Ghee:**

Method:

Put small quantities of ghee on a flat pan. Make small round balls of the dough. Turn these ball into flat round pan cake like structure and place them on pan. When one side become golden brown. Turn the bread so that the other side also becomes brown. Take it out and serve.

Cooking time: 10-15 minutes

b) **Fried Egg:**

Ingredients:

1) Egg
2) Ghee
3) Salt and pepper

Method:

Put ghee in a frying pan and heat it. When it becomes hot, pour contents of egg in it. Fry for one minute and take it out in a plate. Season with salt and pepper.

Cooking time: 5 minutes

c) **Cutlets:**

Ingredients:

1) Potatoes. (boiled and mashed) ½ kg
2) Salt 1½ teaspoon/according to taste
3) Red Chillies powder 1½ teaspoon
4) Garam Masala powder. 1 teaspoon
5) Corriander leaves. ½ cup
6) Green chillies. 3-4 (cut into small pieces)
7) Egg 1 (slightly beaten)
8) Ghee. 125 gms

Method:

Put all ingredients together except egg. Make small round kabab like cutlets. Heat oil in a frying pan. Dip cutlets in egg and fry them when one side become golden brown. Turn to fry the other side. Take these out on an absorbent paper and serve.

Cooking time: 30 - 40 minutes

3. CURRY MAKING

a) **Potato Beef/Mutton Curry:**

Ingredients:

1) Beef or mutton. 500 gms (cut into small square pieces)
2) Potatoes. 500 gms (cut into halves)
3) Ghee. 250 gm
4) Onions. two medium size, cut and sliced:
5) Ginger. garlic paste. 2 teaspoon
6) Salt. 1 teaspoon/according to taste
7) Red Chillies powder. 1 teaspoon
8) Corriander powder. 1 teaspoon
9) Garam masala powder. 1 teaspoon
10) Tomatoes. 250 gms
11) Turmeric powder. 1/4 teaspoon

Method:

First of all heat ghee in a sauce pan. When it becomes quite hot, put finely sliced onions in it. When onions become golden. Put in it ginger and garlic paste, fry for two minutes then put sliced tomatoes and all spices. Cook on low fire for 10 minutes so that all the ingredients forms a paste. Then put meat pieces in it, cook for 5 minutes with constant stirring. Then put four glasses of water and cook under pressure in a pressure cooker for 15 minutes until the meat becomes tender. Then add potatoes and cook for another 15-20 minutes so that the potatoes get tender. When the curry becomes ready, sprinkle corriander leaves and garam masala before serving.

Cooking time: 1½ hour

b) **Gram, (Daal Channa) Beef/Mutton Curry**

Ingredients:

1) Beef or mutton. 500 gms (cut into small square pieces)
2) Gram (Daal Channa) 250 gms. Soaked over night.
3) Ghee. 250 gms
4) Onion two medium size sliced
5) Ginger, garlic paste. 2 teaspoonful.
6) Tomatoes. 250 gms
7) Salt. 1 teaspoon/according to taste
8) Red Chillies powder. 1 teaspoon
9) Corriander powder. 1 teaspoon
10) Garam masala powder. 1 teaspoon
11) Turmeric powder. 1/4 teaspoon

Method:

Heat ghee in a sauce pan. Put sliced onions in it. Fry until golden brown. Put ginger garlic paste and again fry for two minutes. Then put sliced tomatoes and fry till it becomes a paste. Then add meat pieces and fry with constant stirring for 5 minutes. Then add four glasses of water and cook under pressure for 15 minutes. Then add daal channa and again cook under pressure for 20 minutes in a pressure cooker until both daal and meat become tender and curry is ready. Sprinkle with garam masala and corriander leaves before serving.

Cooking time: 1½ hour

c) **Green Peas and Potato Curry (Bhujia):**
Ingredients:

1) Green peas. ½ kg
2) Potatoes. ½ kg (peeled and cut into cubes)
3) Onions. 2 large size (peeled and sliced)
4) Tomatoes. 200 gm (cut into small pieces)
5) Salt. 1 teaspoon (according to taste)
6) Red chillies. 1 teaspoon
7) Corriander powder. 1 teaspoon
8) Turmeric powder. 1/4 teaspoon
9) Cumin seeds. ½ teaspoon
10) Garam masala. ½ teaspoon
11) Green chillies. 3-4
12) Corriander leaves. ½ cup
13) Ghee. 75 gm

Method:

Heat oil in a sauce pan. Put onion and cumin seed in it. When onion becomes golden brown, add tomatoes and all the spices to it. Fry with adding little water for 5 minutes and then add green peas to it. Fry for another 5 minutes. Add a glass of water and let the peas simmer on low flame for 15 minutes, untill they become tender. Then add slice potatoes and again cook on low flame for 15-20 minutes, untill the vegetables become tender and gravy thicken. Then add green chilies, garam masala and corriander leaves. Turn off the heat and let the curry covered for 5 more minutes.Now it is ready to serve with chapaties or nan.
Cooking time: 1 hour

Annexure-III

VITAMIN A (TRANS RETINOL), R.E. FROM ß-carotene AND TOTAL VITAMIN A (TRANS RETINOL + R.E. FROM ß-carotene) IN GHEE SAMPLES

Brand Name	Product Line Samples			Tin Samples		
	Vit A iu/g	R.E from B.Carotene iu/g	Total Vit.A iu/g	Vit A iu/g	R.E from B.Carotene iu/g	Total Vit.A iu/g
Mujahid	19.4	6.7	26.0	18.5	9.5	27.9
Gul	18.2	8.0	26.2	17.6	7.5	25.1
Fauji	16.1	5.4	21.5	15.7	5.1	20.8
Latif	16.9	5.3	22.2	16.1	7.9	24.0
Ashraf	10.3	3.1	13.4	9.4	5.8	15.2
Family	10.6	4.8	15.4	9.7	4.9	14.6
Khushboo*	-	-	-	9.4	6.2	15.6
Shama	18.2	8.6	26.8	17.3	9.1	26.4
Kohialnoor	10.7	5.7	16.4	10.0	6.4	16.4
Gulab	10.9	7.4	18.3	10.3	5.9	16.3
Sehat	11.2	4.7	15.9	9.6	7.1	16.6
Bara*	-	-	-	8.2	7.6	15.8
Kaghan*	-	-	-	7.3	6.3	13.5
kohitoor*	-	-	-	6.7	7.6	14.2
Marhaba	10.6	5.8	16.4	9.4	8.0	17.4
Tawana*	-	-	-	11.2	8.7	19.9
Shahzad	13.3	7.9	21.2	11.5	8.3	19.8
Dargai	14.8	6.6	21.5	13.6	8.1	21.7
Zorawar*	-	-	-	9.7	8.0	17.7

(*) Samples from product line were not available.
Total Vitamin A. Vitamin A (tran retinol) + R.E from B. Carotene

Annex-IV

PERCENT VITAMIN A (TRANS RETINOL) AND PERCENT TOTAL VITAMIN A (TRANS RETINOL + RE FROM ß-carotene) AS COMPARED TO THE REQUIRED LEVEL OF FORTIFICANT 33 iu/g

Brand Name	Percent vitamin A as compared to required level		Percent total vitamin A as compared to required level	
	Product line	Tin	Product line	Tin
Mujahid	58.7	56.0	78.9	84.6
Gul	55.0	53.2	79.4	76.0
Fauji	48.6	47.7	65.1	63.8
Latif	51.3	48.6	67.3	72.7
Ashraf	31.2	28.4	40.5	46.1
Family	32.1	29.3	46.7	44.2
Khushboo*	-	28.4	-	47.3
Shama	55.1	52.3	81.2	79.9
Kohialnoor	31.2	30.3	49.7	49.5
Gulab	33.3	31.2	55.5	49.3
Sehat	33.7	29.0	48.3	50.7
Bara*	-	24.7	-	47.8
Kaghan*	-	22.0	-	41.3
Kohitoor*	-	20.1	-	43.5
Marhaba	32.1	28.4	49.8	52.7
Tawana*	-	34.0	-	60.3
Shahzad	40.4	27.5	64.3	60.2
Dargai	44.7	41.3	65.0	65.7
Zorawar*	-	29.3	-	53.7

*) Samples from product line were not available.

Annexure-V

FACTORIES NAMES, BRANDS NAMES AND ORIGIN OF THE FORTIFICANT USED

Name of the factory	Brand Name of ghee	Origin of fortificant
Hattar		
Hafeez Iqbal Oil & Ghee Mills	Mujahid	Italy
Waheed Hafeez Ghee Mills	Fauji	Italy
Latif Ghee Industires	Latif	Italy
Chiniot Enterprises	Gul	Germany
Hassnain Dawood Oil & Ghee Industries	Ashraf	Italy
Pan-Asia Products (Pvt.) Ltd.	Family	Italy
Peshawar		
Associated Industires Ltd.	Shama	Italy
Ashraf Industries	Kohialnoor	Italy
Bilour Industries (Ltd.)	Gulab	Germany
Gadoon Amazai		
Tor-Dher Vegetable Ghee Mills	Marhaba	Germany
Shahzad Ghee Mills	Shahzad	Italy
Gul Cooking Oil & Vegetable Ghee Mills	Dargai	Italy

Italy : Istituto Delle Vitamins S.P.A. Segrate (Milan) 1008.00 MIU/kg
Germany : BASF Vitamin Mischung 02/118. Vitamin A propionate 1.008 MIU iu/g